2. PROTECTIVE ACTIONS AND REENTRY

2.1 Introduction

Protective Actions are measures, such as evacuation or sheltering, taken to prevent or minimize potential health and safety impacts on workers, responders or the public. These measures are common for both Base Programs and Hazardous Material Programs. Typically, evacuation and sheltering are the primary protective actions considered for use in Base Programs. For Hazardous Materials Programs, additional protective actions such as decontamination, access control, shielding, and others may also be applicable.

Reentry is a planned activity to accomplish a specific objective(s) set by the Emergency Response Organization (ERO), conducted prior to the termination of emergency response, which involves reentering a facility or affected area that has been evacuated or closed to personnel access during the course of the emergency. Reentry activities are time-urgent actions performed during emergency response such as search and rescue, mitigation, damage control, and accident assessment. Some activities performed during recovery are similar to those performed during reentry in that they may involve entering a facility or affected area in which hazardous materials have been released. Therefore, some of the considerations discussed in the reentry section below may also be applicable to recovery operations (See also Volume IV, Chapter 6.)

This chapter provides an overview of the protective action process, including developing criteria for protective actions, determining pre-planned protective actions, and incorporating protective actions into emergency plans and procedures; a system for implementing protective actions during an emergency is also addressed. Protective actions taken during the response to an emergency, such as accountability, protection of workers from hazardous materials, and decontamination, are also covered in this chapter. Planning for and conduct of reentry activities is discussed. Although the focus of the discussions is toward Hazardous Materials Programs, the content is also applicable to Base Programs.

Base Program. The minimum protective action requirements for Base Programs specified in the Order includes plans for evacuation or sheltering of employees, along with provisions to account for employees after emergency evacuation has been completed. If the Base Program site/facility has hazardous materials, though not in significant quantities, the protection of workers involved in response and clean-up is covered by 29 CFR 1910.120. Reentry planning includes contingency planning to ensure the safety of reentry personnel, such as planning for the rescue of reentry teams. All individuals involved in reentry are to receive a hazards/safety briefing prior to emergency response activities, consistent with Federal, state, and local laws and regulations.

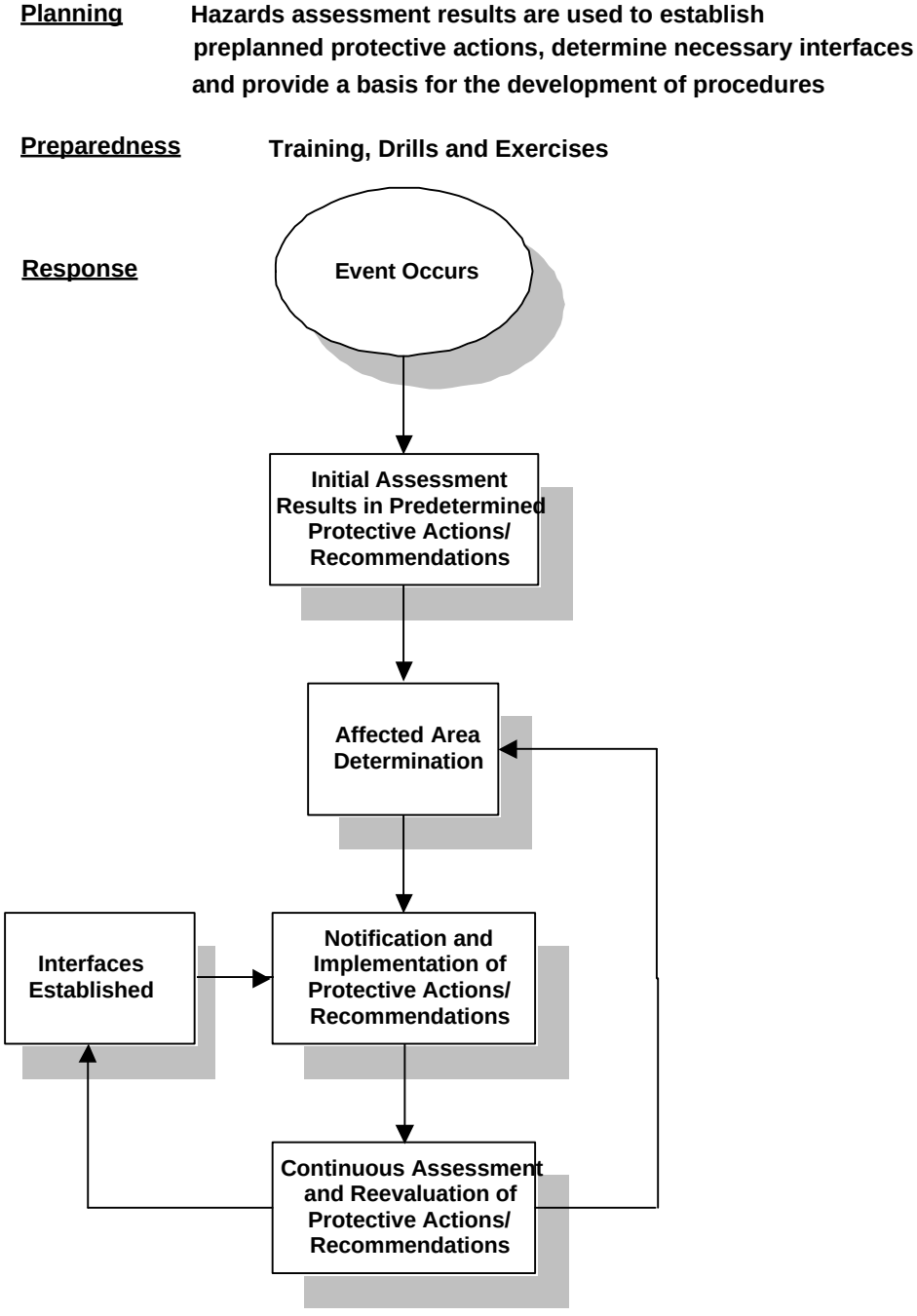
2.2 Protective Action Process

The process for developing protective actions is part of emergency management planning and is one of the direct applications of the results from the Hazards Assessment. The process begins with development of preplanned protective actions. These are often directly linked to the categorization/classification process so that the issuance of protective actions is automatic upon declaration of an Operational Emergency. Next is the determination of who needs to be notified and provided information in order to take protective actions, to implement protective actions and to respond safely. The next step in planning for protective actions is developing plans and procedures for protective actions. Establishment of the ERO staff that will be responsible for determining, recommending and implementing protective actions is the last step of the planning process for protective actions.

Training, drills, and exercises conducted for the ERO staff responsible for protective actions comprise the preparedness phase of emergency planning for protective actions. Preplanned protective actions will be implemented in the very early part of an event, when little information is known about the severity of an incident. Actions need to be taken quickly to protect workers and/or the public. Figure 2.1 shows how the process for protective action determination begins with use of preplanned protective actions. In general, the protective actions of sheltering and evacuation are the same for Base Program facilities as for the Hazardous Materials Programs but are usually only implemented for a localized area, such as a building or facility. Additional types of protective actions are often not warranted for Base Program facilities. The criteria for developing protective actions is discussed in Section 2.3.1.

As seen in Figure 2.1, once continuous consequence assessment is started and additional information is acquired about the event, including the actual release and status of mitigation of the event, reevaluation of protective actions will begin. The reevaluation of protective actions/recommendations is a product of continuous consequence assessment and is performed throughout the response (also see Volume IV, Chapter 1.) The evaluation of habitability for areas being used by responders and sheltered personnel is part of the continuing evaluation for protective actions.

Figure 1. Process of Protective Action Determination



Next is the determination of affected area(s). This topic is discussed in Section 2.3.2. The affected areas may be adjusted as additional information is obtained during an event.

The next step in the process is providing necessary notifications for onsite responders and workers needing to take protective actions and to offsite officials responsible for protecting the public. Notifications are discussed in detail in Volume III, Chapter 4.

2.3 Protective Action Planning

The basis for planning protective actions begins with the Hazards Assessment and analysis. Once the level of hazard is identified and the consequences of a release are identified, the actions necessary to protect the health and safety of the workers and the public can be established. Determining when protective actions are necessary and where those actions must be implemented is the primary concern when planning protective actions.

2.3.1 Protective Action Criteria

Protective action criteria are the predetermined concentrations, doses, or exposures at which protective actions will be initiated.

General. Emergency plans for DOE sites/facilities should identify the methodology to be used to develop criteria for protective action decision making. Emergency procedures for implementing protective actions should incorporate these criteria. For each specific hazardous material identified during the Hazards Assessment process, the numerical criteria should be expressed in units that can be readily correlated with both the potential for health impact (e.g., peak concentration, cumulative dose or exposure) and information that will be available to decision makers during an emergency event, such as observable event indicators, results of consequence calculations, or measurements.

- For planning purposes, all facilities and activities on a given DOE site should use the same protective action criteria for a particular hazard. Also, the same protective action criteria should be applied to onsite and offsite personnel.

- Facility indicators and operating parameter values corresponding to hazardous material releases that will exceed protective action criteria should be identified. They should be incorporated into facility response criteria and/or emergency action levels (EALs) to ensure that the need for prompt protective action is recognized by the person(s) responsible for determining the emergency class and initiating the emergency response.

- Two or more protective action criteria may apply to a particular event or condition (e.g., a mixture of several chemicals or a chemical agent and a radioactive material released together). Unless the combination has been characterized and is known to be more toxic than any of the materials in the mixture, protective action decisions (and recommendations) during the early phase of an event should be based on the substance that comes closest to exceeding its respective criterion.

- The same protective action criteria should be used for onsite transportation activities as for fixed facilities. However, it should be recognized that for transportation events occurring offsite, local authorities may take action independent of DOE based on other criteria. Many offsite authorities rely on the *North American Emergency Response Guidebook* for determining protective action for transportation events involving hazardous materials.

Criteria For Radiological and Non-radiological Releases. The Order specifies that the Protective Action Guides (PAGs) published by the Environmental Protection Agency (EPA) and the Emergency Response Planning Guidelines (ERPGs) published by the American Industrial Hygiene Association (AIHA) are to be used for comparison with exposures resulting from hazardous material releases to determine the appropriate emergency class and associated protective actions. PAGs and ERPGs are sometimes referred to generically and collectively, in this Emergency Management Guide (EMG) and elsewhere, as protective action criteria (PAC). A complete discussion of the definition and use of PAC is presented in Volume II, Appendix B.

2.3.2 Determination of Affected Area

Knowledge of the geographic area within which PAC has been (or will be) exceeded is necessary for decision makers to effectively apply those criteria.

Knowledge of the geographic area includes the identification of all receptors of interest for planning protective actions (see Volume IV, Chapter 1.) Timely initial or continuous assessment estimates are used to provide information for protective action decisions.

Consequence calculations and field measurements should be used to define the area affected by a hazardous material release. Real-time consequence projections may be calculated during a release event, or calculations may be performed in advance for various combinations of release magnitude and dispersion conditions, and the results tabulated for easy reference.

Field measurements should be used to confirm the results of calculations and to refine estimates of the affected area. Reliance on field measurement results as the primary basis for protective action decisions should be limited to those materials and exposure pathways for

which protective action criteria are not likely to be approached in the time necessary to take measurements and analyze the results (such as food pathways).
The facility/site emergency plan for determining the affected area should be coordinated with the plans of offsite officials to ensure mutual understanding of the methods to be used, the type of results likely to be obtained, and the bases for any protective action recommendations that DOE may issue. If the DOE activity and the offsite authorities use different calculational models or measurement methods, differences should be examined and understood during the planning process to ensure that they do not cause confusion or delay in selecting or executing protective actions.

The facility/site emergency plan should provide for integrating the monitoring assets of other offsite agencies, such as regional and national Federal assets (i.e., Federal Radiological Monitoring and Assessment Center, Aerial Measuring Systems, etc.) The plan should also include instructions for requesting radiological emergency response assets and the management approvals needed to make such a request.

2.3.3 Reentry Planning

The facility-specific Hazards Assessment should be the principle resource for determining the range of conditions that need to be considered for reentry planning.

The identification and screening of facility hazards will identify the material hazards that may be encountered during reentry activities. A review of the event scenarios developed during the Hazards Assessment will provide the planner with information concerning the type and nature of possible failures; possible mitigative activities; areas likely to be accessed during reentry; degree and nature of facility damage; and, systems, indicators, or controls which may be non-functional. The consequence estimation process will provide source term information for each event scenario which will help the planner determine the range of hazardous environments that may be encountered by personnel during reentry activities.

The information provided by the facility-specific Hazards Assessment will identify potential reentry activities and help the planner determine the needed support materials and resources. Using information generated during the Hazards Survey or Assessment, facility operations personnel should consider the following: special damage control equipment, provisions for spare parts, availability of back-ups for critical equipment, pre-arranged service contracts, and accessibility of critical items (e.g., controls, indicators, systems, tools and equipment) under emergency conditions. (See also Volume IV, Chapter 5, for information concerning facilities and equipment necessary to support reentry activities.)

2.4 Protective Actions Implementation

The International Commission on Radiological Protection (ICRP) has issued recommendations and guidance on planning for protective actions. The objectives and principles described by the ICRP, and endorsed by the International Atomic Energy Agency (IAEA), are specific to radiological accidents, but are also useful in planning protective actions for hazardous material programs in general. These principles are:

- Severe early health effects should be avoided by taking protective actions to limit individual doses or exposures to levels below the threshold for those effects;

- The risk to individuals should be limited by taking protective actions which produce a positive net benefit to the individuals involved, i.e., the risk to the individual from taking the protective action is lower than the risk from exposure or dose that is thereby avoided; and

- The overall risk to workers and the public should be limited, to the extent practicable, by reducing the population or collective dose (or exposure). The ICRP guidance suggests that dose to emergency workers is as important as dose to the general public in adhering to this principle.

The World Health Organization (WHO) and the ICRP have identified protective actions that can be implemented individually, or in combination, to reduce exposures from a wide range of hazardous material types. These include:

- evacuation,
- sheltering,
- decontamination of people,
- medical care,
- ad hoc respiratory protection,
- control of access,
- shielding,
- radioprotective prophylaxis (e.g. administration of stable iodine),
- control of foodstuffs and water,
- relocation,
- decontamination of land and equipment,
- changes in livestock and agricultural practices.

2.4.1 Evacuation and Sheltering of Workers

Evacuation and/or sheltering are likely to be the most effective protective actions that can be taken to minimize risk to workers close to the event scene. Workers closest to the scene of

an emergency will be subjected to the highest risk from the effects of the accident conditions with the least warning time.

Facilities should ensure that their communications systems allow rapid communication of protective actions to all affected workers. A method should be employed that ensures emergency managers that affected workers have been warned and are implementing protective actions.

Facility plans and procedures should include criteria for evacuation or sheltering of workers. These criteria may be related to event categorization or the declaration of certain emergency classes based on specific EALs. The effectiveness of sheltering in place versus evacuation for different types of events should be considered in establishing criteria.

Sheltering may be the appropriate protective action when:

- The dose or exposure will be less than that associated with evacuation;
- It places workers in a position where additional instructions can be rapidly disseminated;
- Rapid evacuation is impeded; and
- Plume arrival is imminent.

The degree of protection provided by buildings and structures within which workers would take shelter should be considered in facility plans and procedures. The shielding and air change rate provided by the structure are significant factors in determining whether sheltering alone will suffice as a protective action and how long sheltering should be used before evacuation is initiated in order to provide the lowest possible exposure to onsite personnel. Sheltering can provide substantial protection when the building has a low air change rate, the plume passage time is short, or the hazard produces its effects through direct contact exposures. Plans should include steps necessary to enhance the sheltering effects of structures that may be used for that purpose. For example, procedures should direct that doors and windows be closed, ventilation systems be secured, and personnel assemble in the most protected area(s).

Assembly areas, modes of transportation, evacuation routes, and reception centers should be identified in facility plans and procedures and should be clearly identifiable to users. Plans should also describe how evacuation instructions will be provided to onsite personnel and how they will move from personnel accountability areas to assembly (staging) areas for evacuation.

If private vehicles are to be used in evacuation, plans and procedures should make the operation as efficient as possible. Planning should include subjects such as: selecting vehicles with the largest passenger capacity, ensuring that all available passenger seats are filled, ensuring that each vehicle being used has sufficient fuel to complete the trip to the reception area, and organizing vehicles into groups of manageable size (generally not to exceed 20 vehicles in a group.) There should be plans to allow sufficient space between groups to allow other uses of evacuation routes.

Directionally separated facility egress points, assembly areas, evacuation routes and reception areas should be established to provide alternatives to routing evacuees through a plume. Egress routes should be clearly marked within and between facilities, as well as routes leading offsite. Procedures should contain guidelines for determining the optimum choice of egress and destination, as well as prepared, concise, oral announcements for use by emergency managers. Reception areas should be equipped to monitor evacuated personnel for contamination.

Evacuation plans should be closely coordinated with offsite transportation and law enforcement officials because those officials will be expected to establish controls over roads surrounding the facility/site. Such officials would also be the primary source of information on current road conditions created by inclement weather, range fires, earthquake damage, or traffic congestion.

2.4.2 Recommendations to Offsite Agencies

Emergency plans for DOE sites and facilities should provide for the health and safety of offsite personnel through coordinated planning and action with State and local government authorities. Facility and site plans should provide for timely notification with recommendations to state, tribal, or local authorities regarding protective actions for the general public.

- The recommendations should be made to the designated, responsible authorities as soon as possible, but within 15 minutes of recognition that a protective action criterion has been or will be exceeded, *or* that a General Emergency has been declared. Default criteria based on facility conditions should be prepared so that protective action recommendations to offsite authorities can be made in a timely manner, even though consequence projections have not been completed.

- The recommendation may be considered delivered when the content of the message is received and acknowledged by the emergency operations center, communications center, or central warning point(s) serving the offsite agencies.

- Each notification message to offsite authorities concerning the declaration of an emergency or change in emergency condition should restate the protective actions being recommended, even if the recommendation is "no protective action."

The protective action recommendations to offsite authorities should be formulated using the same types of criteria developed for decisions on evacuation or sheltering of site workers. The following information should be provided to offsite authorities for their consideration in implementing the facility's recommendations.

- The time available for carrying out the protective action before the onset of the impact (i.e., plume arrival).

- The specific areas within which protective action criteria may be exceeded, as calculated from the quantity of material released, the event type, and the meteorological conditions, or as determined from environmental sampling and monitoring results.

- The relative effectiveness of the different possible protective actions, considering the material and the release type. For example, sheltering in place may be as effective as evacuation for a short-duration gaseous release. For acutely toxic materials in high concentration, sheltering may be the only practical alternative unless evacuation can be completed before plume arrival.

- If state and local authority guidelines differ from the facility's PAC, the facility should also provide offsite authorities with the equivalent information related to the state/local guidelines.

2.4.3 Other Protective Actions

Other possible protective actions (e.g., in addition to sheltering and evacuation) have been identified by the WHO, the ICRP, and the IAEA. Some of these may be useful in certain circumstances and should be considered in developing onsite response plans. Others will be primarily, or exclusively, the concern of offsite authorities but are discussed briefly here as background for DOE and contractor personnel who will carry on a planning dialogue with those responsible for offsite protective actions. DOE and contractors should coordinate with responsible offsite agencies to plan for the recommendation and implementation of these protective actions for the facility and hazards of concern.

- **Ad Hoc Respiratory Protection.** Ad hoc respiratory protection is a cost-effective action that can significantly reduce inhalation of some hazardous materials by both workers and the general public. Ad hoc respiratory protection is especially useful in

rapidly-occurring events. Effective protection against the inhalation of particulates and some gases can be provided through the use of readily-available materials such as handkerchiefs, towels, and cloth. Wetting a cloth can increase its efficiency as a breathing filter for some materials.

- **Control of Access.** Control of personnel access to affected areas can prevent unnecessary exposures and minimize the spread of contamination. It also minimizes interference with emergency response activities. Access control is most effective when implemented immediately upon recognizing that an area has been, or will be, affected by a hazardous material release.

- **Shielding.** Protection from radiation can be provided by an attenuating material between the source and potentially exposed people. The shielding provided by a structure is one factor that determines whether people can be effectively sheltered in that structure. For most radioactive releases, the ability of a structure to limit infiltration of outside air, thereby reducing inhalation exposure, is far more important than the shielding it can provide and will largely determine its suitability for sheltering personnel.

- **Radioprotective Prophylaxis.** To be effective, iodine prophylaxis requires both considerable planning and warning of the potential exposure. For greatest effectiveness, the stable iodine should be taken before or shortly after exposure. Because reliable radiological measurement information may be lacking during the initial stages of an event, the decision to administer stable iodine should be based on planned estimates of exposures and risk. The selection of the use of stable iodine as a protective action must be based on a careful evaluation of net benefit. Problems with administering stable iodine include identifying the affected population, distribution, and adverse health affects on a small percentage of the population. Other prophylactic measures include the administration of chelating agents or diuretics to speed the removal of specific radionuclides from the bodies of exposed individuals.

- **Control of Foodstuffs and Water.** An event with offsite environmental consequences may require implementing controls on the distribution of contaminated food and water. Although implementation of these actions offsite will be the responsibility of state and Federal health officials, DOE and its contractors may need to assist those agencies in developing intervention levels for specific hazardous materials and also manage onsite potable water supplies. Banning the sale of and preventing the consumption of contaminated foodstuffs imposes minimal risk but may have significant costs. Selection of protective actions for control of foodstuffs and water may initially be based on the predicted or measured ground deposition. At later

stages, measurement of the concentrations of hazardous materials in foodstuffs and water should be available to refine decisions. Contamination of water supplies as a result of an airborne release is not likely to be a source of significant exposure. However, special consideration should be given to people who may consume rainwater or untreated water supplies. Long-term control of foodstuffs and water requires consideration of several factors. These include the availability, quality, and cost of alternative food sources; costs and resources associated with monitoring, control, and disposal; and rate at which the hazardous material is introduced to the foodstuffs.

- **Relocation.** Relocation of individuals can be implemented when emergency response is terminated. Relocation can be an extension of an evacuation, or it can be initiated in the later stages to facilitate decontamination efforts. The duration of the relocation depends on the natural and remediation activities eliminating the hazard. Procedures to determine the advantages and disadvantages of relocation and its net benefit are different from those of evacuation. The costs and impact of relocation will depend upon the number of individuals affected and the social and economic disruption created.

- **Decontamination of Land and Equipment.** Decontamination of land and equipment can prevent the spread of contamination and reduce or eliminate exposures. The projected dose to decontamination workers should be weighed against the dose to the public that will be averted. Decontamination efforts will generate large volumes of waste requiring disposal. While decontamination of small areas may be practical and cost effective, decontamination of large areas may be very difficult and costly. Detailed planning for decontamination is conducted during the recovery phase of response.

- **Changes in Livestock and Agricultural Practices.** The contamination of pastures and agricultural areas due to the deposition of released materials can require specific protective actions to minimize introduction of the contamination into the human food chain. Actions could include putting livestock on stored feed, delaying slaughter of animals until the hazardous material has been removed from their systems, and treating the soil with fertilizers to minimize the uptake of the hazardous material into foodstuffs. The use of severely contaminated land for agricultural purposes may have to be prohibited.
- **Medical Care.** Several regulatory requirements and directives state criteria for medical support that must be in place for workers, including those with radiological and/or hazardous material contamination. Planning for and identifying resources to provide fundamental medical care for members of the general public in the event of an accident should be carried out as part of the protective actions element. When

evaluating the selection of medical care as a protective action, consideration should be given to the treatment and documentation of injuries and illness and to reducing patient anxiety by explaining the potential benefits of treatment. Additional guidance on this subject is found in Volume IV, Chapter 3.

2.5 Protective Action Response

2.5.1 Accountability

Regulations, such as 29 CFR 1910.38, require employee emergency action plans, including "procedures to account for all employees after emergency evacuation has been completed." All DOE facilities are subject to this basic workplace safety requirement, which is generally considered to be met if designated persons (e.g., zone wardens) verify that no one remains inside an evacuated building and all evacuees meet at staging areas outside the building for an informal head count. The Order states that provisions be in place to account for employees after emergency evacuation has been completed. Each facility should establish a goal for the amount of time required to do this consistent with the facility hazards. A time-frame of 30 to 45 minutes is an accepted industry practice. To satisfy the intent of the Order requirement for accountability, facility emergency response staff should be able to identify any missing persons or establish that no persons in the facility are in need of assistance or rescue within 30 to 45 minutes from the recognition and classification of an emergency. Accountability of response workers should be maintained, once established.

The objective of accountability procedures is to ensure that search, rescue, and assistance efforts can be initiated promptly to help provide for the safety of facility personnel who may be injured, trapped, or unaware of the emergency condition.

Whether all facility personnel have or have not been accounted for should be a major consideration in an incident commander's "sizing up" a situation (National Fire Protection Association Standard 1021, Section 2-10) and one basis for the decision to risk the lives of rescue personnel in a hostile environment to search for victims. In keeping with the principles of protective action, risk to search and rescue personnel should be weighed against risk to missing workers. Positive accounting of facility personnel helps minimize risk to search and rescue personnel.
In high hazard areas, a positive control system, such as a log or badge/card reader that records the entry and exit of employees, should be considered. Where the potential for exposure to high levels of hazardous materials is low, such as in an office building, a less formal accountability system may suffice. A procedure whereby designated individuals search each work area upon evacuation to ensure that no persons remain should be sufficient for such low-hazard areas.

A goal of 30 minutes for full accountability should be met in areas where workers might be subject to risk of death or serious injury and where search and rescue operations might pose a significant risk to emergency personnel. Use of a positive control system can help achieve this goal. Specific examples of facilities where a positive control system should be applied are (1) where the nature of the facility operation is such that people might become quickly trapped or incapacitated by the event so they cannot take action to protect themselves (explosions, rapid release of incapacitating materials, nuclear criticality) or (2) where there is substantial risk of personnel being out of communication and thereby unaware of the hazard and the need to evacuate (remote areas with poor alarm/public address coverage, high-noise areas).

A short duration accountability time standard, or a positive accountability system, need not necessarily be applied to an entire "facility" but may be applied to that part of a facility or complex that contains the hazard.

2.5.2 Protection of Response Personnel During Reentry Activities

Planning and actual conduct of reentry activities must consider that each emergency event is unique. Therefore, the response structure for conducting reentry activities must be flexible and capable of responding to a wide range of conditions.

Reentry Decision-Making

Reentry activities will often involve high risk, time-urgent actions. ERO management may be called upon to make rapid risk versus benefit type decisions and then to establish priorities for selected activities. Therefore, it is important that emergency plans and accompanying implementing procedures provide the necessary structure and guidance:

- The emergency plan should identify the position within the ERO with the authority and responsibility to authorize reentry activities and approve doses/exposures that may exceed occupational or administrative limits.
- The implementation of selected reentry activities should be carried out by elements of the ERO closely associated with the facility, located at the event scene or affected area.

- To assist with the decision-making process, training and procedures should address the following:

    - Criteria and guidance to assist in prioritizing reentry activities should be provided. Consideration should be given to the benefit achieved as well as the availability of qualified personnel and resources to carry out any given activity.

Information and requests regarding reentry activities should be forwarded to the ERO position having decision-making authority. A means to record and indicate the priority of proposed activities and track progress on authorized activities should be provided.

- Criteria and guidance to assist in making risk versus benefit determinations should be provided. Consideration should be given to protecting the health and safety of workers and the general public, minimizing damage to the facility, and limiting environmental impact or damage. A means for estimating exposure to hazardous material during the reentry activity should be provided. The possibility that the reentry activity could cause a release or worsen an existing release of hazardous material should be considered. Means to estimate consequences of a potential release on workers, the public, and the environment resulting from reentry activity should be provided.

- Criteria and guidance to assist in making decisions concerning the authorization of emergency dose or exposure should be provided.

- A mechanism for coordinating reentry activities within the site ERO and with state, local and other Federal agencies as necessary should be provided. As a minimum, information regarding reentry activities planned and in progress should be provided to these agencies. Priority should be given to communication of any pertinent information acquired during reentry activities (e.g., source term information, release duration, facility status.)

Reentry Operations

Once the decision has been made to perform a reentry activity, planning for the reentry activity should be performed by personnel responsible for managing the on-scene response. They should have direct access to the most current information, be familiar with the facility or event area, and have knowledge of the personnel and resource requirements of the task. One position at the facility or incident scene level should be vested with the responsibility to coordinate the reentry planning process. Responsibilities of this position might include identification of personnel and equipment needs, determination of personnel protection requirements, assignment of personnel to reentry teams, job planning, team briefing/training, monitoring progress of activities, de-briefing teams, and collecting data upon completion. During both planning and preparation, this position may require the support of several other disciplines such as: health physics, industrial hygiene, industrial safety, facility operations, engineering, medical, security, and others.

The following items should be considered when planning reentry activities and preparing reentry teams:

- Provide procedures and/or checklists to ensure that all factors are considered prior to dispatching reentry teams. Reentry planning should use the most current status information; provisions should exist for modifications as new information is received. Each team should receive a briefing prior to dispatch that covers all safety and job specific aspects of their assignments.

- Reentry planning should make use of all available information regarding interior configurations, locations of hazards, etc. Pre-fire plans are particularly well suited for use in such planning.

- Reentry preparation should include contingency planning to ensure the safety of reentry personnel, such as planning for the rescue of reentry teams.

- Provide guidance on selection of reentry team members. Teams should consist of the minimum number required to perform the job but should not be less than two persons. Team members should be chosen based upon job qualification, training, proficiency in use of protective equipment, and exposure history (radiological) or sensitivity to toxic material. For very high risk tasks, volunteers should be used. Criteria should be developed to determine what constitutes a "high risk" task and how to select the most appropriate volunteer for a given task. Criteria for selection of volunteers may differ for radiological versus toxic material events. If feasible, volunteers should be evaluated with respect to age, health, and previous exposure history (for radiation exposure). Each volunteer should be advised of the known or anticipated hazards prior to participation.

- Provide personnel performing reentry planning with training and guidance on the selection of appropriate protective clothing and equipment. Identify ERO positions (or other personnel) with the technical expertise and the responsibility to determine what protective equipment and clothing is appropriate for the situation at hand.

- Under some circumstances, the control of contamination may be a concern. Reentry planning should address methods for reducing the spread of contamination and ensuring that reentry activities do not inadvertently increase the actual or potential release of hazardous material.

- Ensure that adequate job planning is performed prior to team dispatch. Even the simplest jobs may become much more complex under accident conditions. Thorough team preparation for the job is critical for the safety of the team members and the

success of the task. Make sure that each team understands the job to be performed and that each team member understands their role. Some job preparation items to be considered include procedures, checklists, parts, tools, test equipment, use of "dry-run" or mock-up training, and appropriate monitoring equipment (health physics and/or industrial hygiene).

- Each reentry team should be provided with a primary and back-up means of communication. Prompt reliable communications are necessary to notify teams of changing conditions, monitor job progress, provide additional instructions, and contact with those responsible for reentry control activities.

- Immediately upon return from completing a reentry assignment, teams should be de-briefed. The de-briefing should be designed to collect information relating to the job performed, facility status, conditions encountered, and exposure received. Information should be recorded and passed on to appropriate ERO positions.

- Provide access to records and documents necessary for reentry planning. Training, job qualification, and dosimetry records may be necessary for team selection and assignment. Engineering drawings, procedures, and technical references may be necessary for job planning.

Reentry for "Rescue and recovery"

This section provides guidance for determining appropriate actions for the rescue and recovery of persons and the protection of health and property during emergency response. 10 CFR 835.1302 contains requirements to be met when conducting these operations in response to a radiological hazard. The regulation provides dose guidelines for the control of exposure during specific types of activity. Although the regulation is designed for response to radioactive releases, the basic principles apply to any type of hazardous material response. The regulation begins with three basic principles: "1) The risk of injury to those individuals involved in rescue and recovery operations shall be minimized, 2) Operating management shall weigh actual and potential risks to rescue and recovery individuals against the benefits to be gained, and 3) Rescue action that might involve substantial risk shall be performed by volunteers."

General Considerations. The risk of injury to persons involved in rescue and recovery activities should be minimized, to the extent practical. Control of exposures should be consistent with the immediate objectives of saving human life; recovering deceased victims; and/or protection of health, property, and the environment.

- Personnel managing response activities should exercise judgement to evaluate any proposed action involving exposure. Evaluation should consider risk versus benefit, e.g., weighing the risks of health impacts, actual or potential, against the benefits (i.e., social, economic, etc.)

- Decisions governing rescue and recovery activities often have to be made on a time urgent basis. Emergency Planners should develop guidance and a methodology to assist decision makers in rapidly evaluating risk versus benefit. Guidance should also recognize that accident situations involving the saving of human lives will require different evaluation bases than those required to recover deceased victims or to protect property.

- Before dispatching any reentry teams, the Emergency Manager or the Incident Commander should ensure that the activities have been coordinated with the head of the organization providing the reentry team members (e.g., if the fire department is providing the reentry personnel, the Emergency Manager/Incident Commander will coordinate with the responsible fire department officer on the scene.) This discussion should ensure that all operational and safety concerns are resolved prior to team dispatch.

- For controlling exposures to radiological hazards, the EPA has prepared guidance and criteria which is presented in *Manual of Protective Action Guides and Protective Actions for Nuclear Incidents*. EPA limits for workers performing emergency services apply only to doses incurred during an emergency. Per 10 CFR 835.202(a), exposures received in emergency exposure situations are not included in meeting the occupational exposure limits to general employees resulting from DOE activities. The EPA Manual also provides tables with general information that may be useful in advising workers of risks of acute and delayed health affects associated with large doses of radiation.

- Due to the uncertainties, the general approach taken by hazardous material responders has been to only perform entries while using the maximum protective equipment for the most severe hazards present. For extraordinary circumstances (e.g., life saving activities, protection of large populations) guidance and criteria should be provided for determining the minimum acceptable level of worker protection. Guidance and criteria should be consistent with that governing hazardous material response for private industry. Guidance, criteria, and technical information concerning response to hazardous materials have been published by a number of organizations and Federal agencies including the Occupational Health and Safety Administration (OSHA), EPA, the Department of Transportation (DOT), the Federal

Emergency Management Agency (FEMA), National Fire Protection Association (NFPA), AIHA, and others.

Emergency Situations. This section presents dose criteria and judgement factors for three types of emergency action: saving of human life; recovery of deceased victims; and protection of health and property. 10 CFR 835.1302 contains requirements for emergency exposure during rescue and recovery activities.

- **Saving of Human Life or Protection of Large Populations**. If the victim is considered to be alive, the course of action should be determined by the individual in charge of the on scene response activity. The potential amount of exposure to rescue personnel should be evaluated, and an exposure objective should be established for the rescue mission. The evaluation of the inherent risks should consider:

  - The reliability of the prediction of injury from measured/estimated exposure rates. In this context, consideration should be given to the uncertainties associated with the specific instruments and techniques used to estimate the exposure rate. This is especially crucial for exposure to radiation when the estimated dose approximates 100 rad (1 gray) or more.

  - The effects of acute external and/or internal exposure.

  - The capability to reduce risk through physical mechanisms such as the use of protective equipment, remote manipulation equipment, or similar means.

  - The progress of any mitigative efforts that would decrease or increase risk.

  - The probability of success of the rescue action.

- **Recovery of Deceased Victims**. The recovery of deceased victims should be well planned. Except as provided below, the amount of exposure received by persons in recovery operations should be controlled within existing occupational exposure limits.

  - When fatalities are located in inaccessible areas due to high risk, and when the recovery mission would result in exposure in excess of occupational exposure limits, special remote recovery devices should be considered for use in retrieving bodies.

  - When it is not feasible to recover bodies without personnel entering the area, the official in charge may approve personnel to exceed occupational exposure

limits. This approval, for an individual, should not exceed 10 rem ((0.1 sievert) in any year.

- **Protection of Health and Property**. When the risk (probability and magnitude) of the hazard either bears significantly on the state of health of people or may result in loss of property so that immediate remedial action is needed, the following criteria should be considered:

  - When it is deemed essential to reduce a potential hazard to protect health or prevent a substantial loss of property, a planned exposure objective for volunteers should be established not to exceed 10 rem (0.1 sievert) for an individual in a year. Under special circumstances, an exposure objective for volunteers not to exceed 25 rem (0.25 sievert) in any one year may be set.

  - When the risk of exposure following the incident is such that life might be in jeopardy, or there might be severe effects on health or the public or loss of property inimical to the public safety, the criteria for saving of human life should apply.

2.5.3 Management of Personnel Exposures

Careful management of personnel exposures and appropriate follow-up can minimize the risk of adverse health effects. If possible, exposures should be maintained within existing occupational (or administrative) exposure limits.

Procedures should establish methods of controlling access to areas where hazardous material contamination might be encountered. The responsibility for controlling access to and activities within such areas should be assigned by the ERO.

Methods should be established for assigning personnel to tasks within the controlled area and managing their exposures, to include: defining the physical, training, and other required personnel qualifications; conducting briefings or specialized instruction on the task to be done and hazards to be encountered; determining allowable exposures and establishing limits on exposure or stay time; issuing appropriate protective clothing and equipment; providing devices or instruments with which to monitor exposures to the hazard; recording the movement of personnel in and out of the controlled area and the exposure, dose, or level of contamination encountered; recording and tracking accumulated emergency exposure; and, if necessary, decontaminating personnel after they exit the controlled area.

Records of emergency worker exposure to hazardous materials should be maintained during and following emergency events. Applicable requirements for maintaining hazardous material

exposure records are found in 29 CFR 1910.1020. Requirements for medical programs are found in DOE 440.1 and in 29 CFR 1910.120.

Additional criteria, such as the following, should be considered in delineating responsibility for reentry actions:

- Guidance and criteria for controlling exposures to workers should be developed and presented in procedures to assist in decision-making. Guidance should be provided to assist in determining what activities warrant consideration of exceeding normal exposure limits. Criteria should be developed that establish exposure bounds for specific types of activities.
- A policy governing the use of prophylactic drugs for dose reduction purposes should be created. Specific guidance on implementing that policy should be incorporated in procedures.
- The risks from entering an environment containing unknown quantities of chemical toxins is very different than the risk stemming from exposure to radiological material. The availability of installed instrumentation or portable monitoring equipment capable of detecting levels of toxic chemicals that could cause severe health effects or death may be limited. The lack of instrumentation, coupled with the uncertainty of projecting transport in a facility or the environment, makes it very difficult or impossible to accurately calculate estimated exposures to reentry personnel that represent an acceptable risk.
- Although the concept of "As Low As Reasonability Achievable" (ALARA) was created as a general goal for reducing normal occupational exposure to radiation, it is also a useful guide for controlling emergency exposures to hazardous materials during emergency response.

2.5.4 Decontamination

Personnel, vehicles, and equipment evacuated from the area affected by a hazardous material release may be contaminated. Decontamination can reduce the health hazard to the evacuees themselves and to others who might later come in contact with contaminated people or articles.

Facility plans and procedures should provide for monitoring of personnel, vehicles, and equipment leaving areas potentially affected by a hazardous material release. If possible, monitoring should be done before the personnel or equipment leave the DOE site. Personnel and vehicles found to be contaminated should be directed to predetermined decontamination stations and decontaminated to established levels prior to release. Decontamination stations should be stocked with adequate supplies, equipment, and procedures to support all decontamination activities. Intervention criteria should be included in procedures. Antidotes

and MSDSs should be available. Provisions should be made for collecting, documenting, transporting, and analyzing all samples, including biological samples.

For personnel who have been severely injured, medical treatment should take priority over decontamination. Procedures should also address the monitoring and decontamination of vehicles used to transport injured and contaminated victims. Memoranda of understanding with local hospitals and ambulance services should address transport, receipt, and treatment of contaminated victims and decontamination of equipment, facilities, and the disposal of wastes.

Procedures should address methods used to limit the spread of contamination from the victim to their surroundings during transportation to pre-designated facilities for treatment and later decontamination of injured personnel. (Also see Volume IV, Chapter 3)

Decontamination should occur in existing facilities, if possible. If decontamination facilities of the appropriate type do not exist on the site, or if existing decontamination facilities would not have the necessary capacity or would be made unusable as a result of the emergency, procedures should identify alternate methods or provide for establishing temporary facilities. Decontamination methods to be employed will depend on the types of contamination and the type of work activities performed during the response.

Monitoring of individuals and equipment should be performed at appropriate stages during decontamination to ensure that decontamination has been successful.

Decontamination plans and procedures should provide for containment and disposal of contaminated wash and rinse solutions and contaminated articles in compliance with state and Federal regulations.

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